Technical Note

Dynamic Anterior Glenohumeral Capsular Ligament Tensioning During Arthroscopic Shoulder Stabilization in Overhead-Throwing Athletes

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Abstract: Although the most common surgical treatment for traumatic anterior shoulder instability is arthroscopic Bankart repair (ABR), which has shown good postoperative results, a potential risk of postoperative external rotation deficit exists. For overhead-throwing athletes, recovery of postoperative range of motion during abduction and external rotation is essential to return to preinjury performance levels. We consider that the key to returning to play after ABR on the dominant side in overhead-throwing athletes is to simultaneously gain anterior stability and mobility of the shoulder. However, no gold standard method for determining the appropriate tension of the glenohumeral capsular ligaments in overhead-throwing athletes exists. This Technical Note presents the dynamic anterior glenohumeral capsular ligament tensioning in the abduction and external rotation positions during ABR for the dominant side in overhead-throwing athletes. We consider this surgical technique to be reliable for traumatic anterior instability of the dominant shoulder in athletes who wish to return to overhead-throwing sports.

Traumatic instability of the dominant shoulder in overhead-throwing athletes is an uncommon but complex condition. Surgical management of traumatic shoulder instability on the dominant side in overhead-throwing athletes has been reported to have a lower rate of recurrent dislocation compared with that observed with contact or collision athletes.[1] However, recent studies have shown that the postoperative return to the same level of performance in overhead-throwing athletes with traumatic shoulder dislocation on the throwing side is less satisfactory, with rates ranging from 45% to 68%.[1-4]

The tension in an overhead thrower's shoulder should be sufficiently lax to allow excessive external rotation in abduction in the late cocking phase while maintaining stability, referred to as the "thrower's shoulder paradox."[5] Therefore, postoperative instability or deficit in abduction and external rotation (ABER) would cause unsatisfactory surgical results.[2,5,6] We believe that it is essential to restore whole anterior glenohumeral ligament retensioning, including the inferior glenohumeral ligament (IGHL) and middle glenohumeral ligament (MGHL), after arthroscopic Bankart repair (ABR) with less restriction of external rotation in the shoulders of overhead-throwing athletes during abduction. However, no gold standard method for determining the appropriate tension of the glenohumeral capsular ligaments in overhead-throwing athletes exists. In this Technical Note, we describe dynamic anterior glenohumeral ligament tensioning (DAGHT) in the ABER position during ABR in overhead-throwing athletes with traumatic shoulder dislocation on the dominant side.

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Surgical Technique

This study was approved by the institutional review board (approval number 2301); all patients provided informed consent regarding participation and publication of the study (August 24, 2023). Our surgical technique is demonstrated in Video 1. Surgical indications are summarized in Table 1. Pearls and pitfalls of the surgical technique are summarized in Table 2, and the advantages and disadvantages are listed in Table 3.

Anesthesia and Positioning

Both shoulders are preoperatively examined for range of motion and laxity under general anesthesia. An interscalene block is administered to control postoperative pain. Patients are placed in a beach-chair position using a spider limb positioner (Smith & Nephew, Memphis, TN).

Portals and Arthroscopic Diagnosis

Standard anterior, anterosuperior, and posterior portals are used in all patients. The presence of glenohumeral joint pathologies such as capsulolabral lesions (Fig 1), glenoid defects, glenohumeral ligaments, Hill-Sachs lesions, SLAP lesions, and articular side of the rotator cuff tear are carefully evaluated. Internal impingement of the SLAP lesion and partial rotator cuff articular side tear in the ABER position are evaluated, and debridement is performed until no impingement is observed.

Capsulolabral Complex Detachment and Mobilization

The capsulolabral complex is sufficiently detached and mobilized from the glenoid neck using a tissue elevator, starting from the 1- to 2-o'clock position to the 7-o'clock position in the right shoulder, ensuring that the subscapularis muscle is visible (Fig 2). After the capsulolabral complex is released, a small amount of articular cartilage (<3 mm) is removed from the anteroinferior glenoid face to promote tissue healing (Fig 3).

Anchor Insertion and Suture

Four to six suture anchors loaded with No. 2 high-strength sutures (GRYPHON BR; DePuy Mitek, Raynham, MA) are inserted at the edge of the glenoid from the 6-o'clock position to the 1- to 2-o'clock position. The first anchor is inserted at the 6-o'clock position. While grasping and pulling the anteroinferior capsulolabral complex up, the suture is passed through the IGHL complex using a suture passer (SutureLasso; Arthrex, Naples, FL) (Fig 4) and tied. To prevent overtightening, suture passage, usually 5 mm wide, to the capsule-labrum complex is performed. It is important to avoid creating excessive "bumpers." The same procedure is repeated once or twice to repair the IGHL complex until it reaches the 4-o'clock position (Fig 5).

The highlight of this procedure is to dynamically decide the tensioning of the anterior-to-anterosuperior capsulolabral complex, including the MGHL. Dynamic evaluation of anterosuperior glenohumeral capsular ligament tension is performed at the mimic position during the throwing motion. After anchor insertion, the capsulolabral complex is grasped using a grasper and provisionally reduced to the anchor insertion site. Subsequently, in the ABER position, the proper tension of the anterosuperior glenohumeral capsular ligaments is dynamically evaluated while maintaining the

Table 1. Surgical Indications of DAGHT in the ABER Position During ABR on the Dominant Side of Overhead-throwing Athletes

- Evidence of anterior shoulder dislocation
- Overhead-throwing athletes
- True apprehension
- Failure to return to play
- No severe glenoid bone loss
- No multidirectional instability
- No severe glenohumeral joint osteoarthritis

ABER, abduction and external rotation; ABR, arthroscopic Bankart repair; DAGHT, dynamic anterior glenohumeral capsular ligament tensioning.

Table 2. Pearls and Pitfalls of DAGHT in ABER Position During ABR for the Dominant Side in Overhead-Throwing Athletes

Pearls
- Careful checking of the site of the suture passage in the ABER position to avoid overtightening the capsule when repairing the anterior to the anterosuperior glenohumeral capsular ligaments
- Avoiding creation of too many "bumpers" because of overtightening
- The anterior superior capsule, including the MGHL, is visible in the ABER position, but not in the resting position.
- Adequate postoperative rehabilitation to avoid external rotation deficits

Pitfalls
- The conventional suture position (resting position) may fail to recognize when the capsulolabral complex is anteriorly displaced from the glenoid edge, leading to an improper suture site and overtightening of the capsule.
- Creating too many "bumpers" reduces the range of motion
- Inappropriate rehabilitation

ABER, abduction and external rotation; ABR, arthroscopic Bankart repair; DAGHT, dynamic anterior glenohumeral capsular ligament tensioning; MGHL, middle glenohumeral ligament.

Table 3. Advantages and Disadvantages of the Surgical Technique

Advantages
- Low risk of postoperative external rotation deficit
- Proper retensioning of the MGHL and IGHL complexes leads to improved postoperative results.

Disadvantages
- The decision regarding the suture passage site is subjective.
- If the anterosuperior glenohumeral capsular ligaments, including the MGHL, are hypoplastic, restoring anterior stability using our surgical technique may not be successful.
- Unknown biomechanical results IGHL, inferior glenohumeral ligament; MGHL, middle glenohumeral ligament.

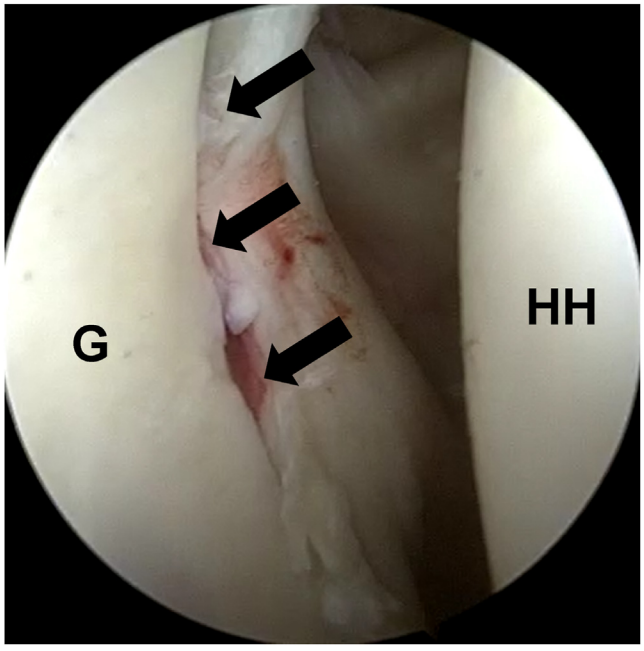

Fig 1. View from the posterior portal of the right shoulder in the beach-chair position. Capsulolabral lesion is marked by the arrows. (G, glenoid; HH, humeral head.)

reduced position (Fig 6). The suture is passed through the capsulolabral complex at a location grasped by the grasper (Fig 7A) and tied firmly (Fig 7B). The same procedures are repeated once or twice for anterosuperior capsulolabral complex repair with DAGHT in the ABER position technique from the 3-o'clock position to the 1- to 2-o'clock position (Fig 8).

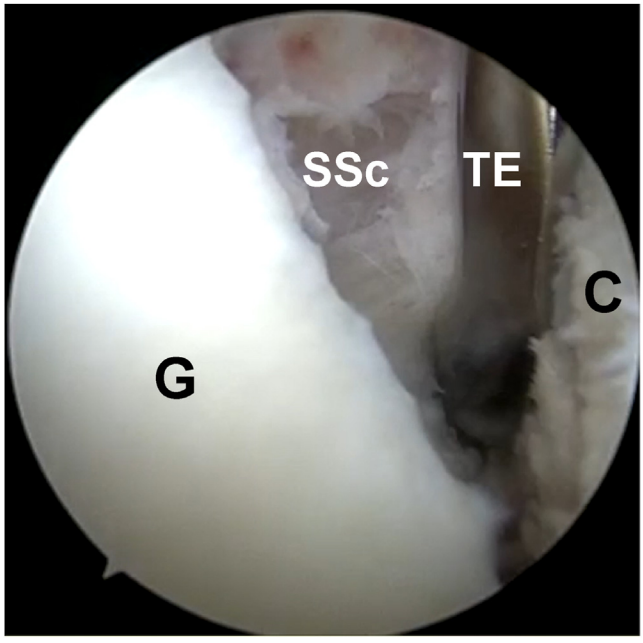

Fig 2. View from the posterior portal of the right shoulder in the beach-chair position. The capsulolabral complex is sufficiently detached and mobilized from the glenoid neck using a tissue elevator, starting from the 1- to 2-o'clock position to the 7-o'clock position in the right shoulder to ensure that the subscapularis muscle is visible. (C, capsulolabral complex; G, glenoid; SSc, subscapularis; TE, tissue elevator.)

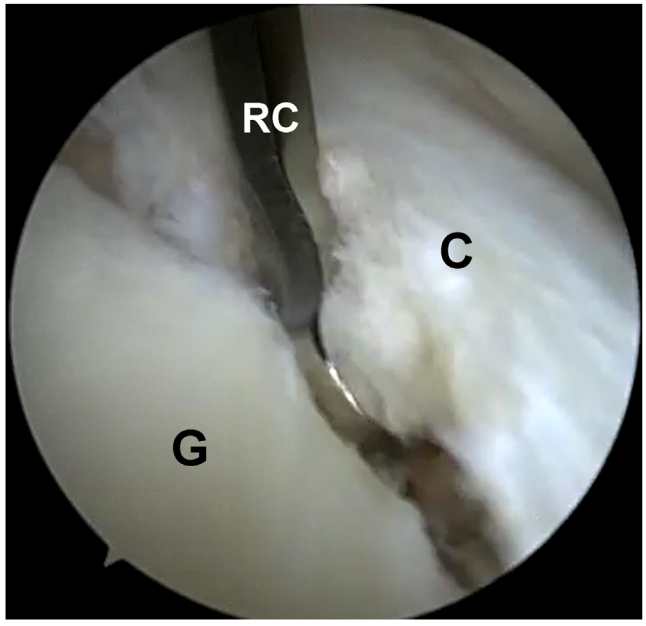

Fig 3. View from the posterior portal of the right shoulder in the beach-chair position. A small amount of articular cartilage (<3 mm) on the anteroinferior glenoid face is removed using a ring curette to promote tissue healing. (C, capsulolabral complex; G, glenoid; RC, ring curette.)

We found that the position of the anterior superior capsular complex changed between the resting (Fig 9A) and ABER positions (Fig 9C). Nylon was sutured as a marker for the MGHL (Fig 9 B and D). Another advantage of the DAGHT technique is that the anterior superior capsule, including the MGHL, is visible in the ABER position (Fig 10A), although it is invisible in the resting position (Fig 10B).

Postoperative Management

After 3 weeks of immobilization using a sling, passive and assisted active exercises are initiated while avoiding pain provocation. A strengthening program and throwing motion are permitted after 12 weeks of surgery. Full return to play is allowed 6 to 8 months postoperatively, according to the functional recovery of each patient. To avoid recurrence, the patients are prohibited from head-first sliding and diving for 8 months and use a shoulder supporter for 1 year after surgery.

Discussion

Surgical management of traumatic shoulder instability on the dominant side in overhead-throwing athletes remains challenging. Despite the lower rate of recurrent dislocation compared with that in collision athletes, a low return-to-play rate, especially a low return to the same level rate, is considerable.[1-4]

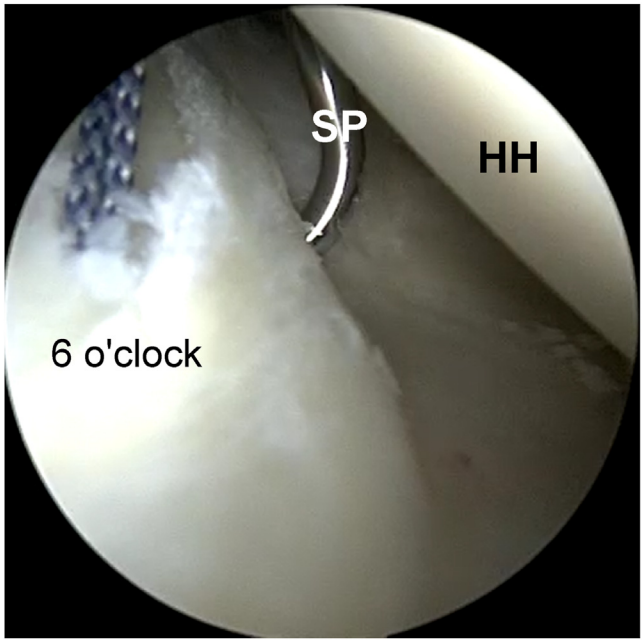

Fig 4. View from the posterior portal of the right shoulder in the beach-chair position. While grasping and pulling the anteroinferior capsulolabral complex up, the suture is passed through the inferior glenohumeral ligament complex with a 5-mm width using a suture passer. (HH, humeral head.)

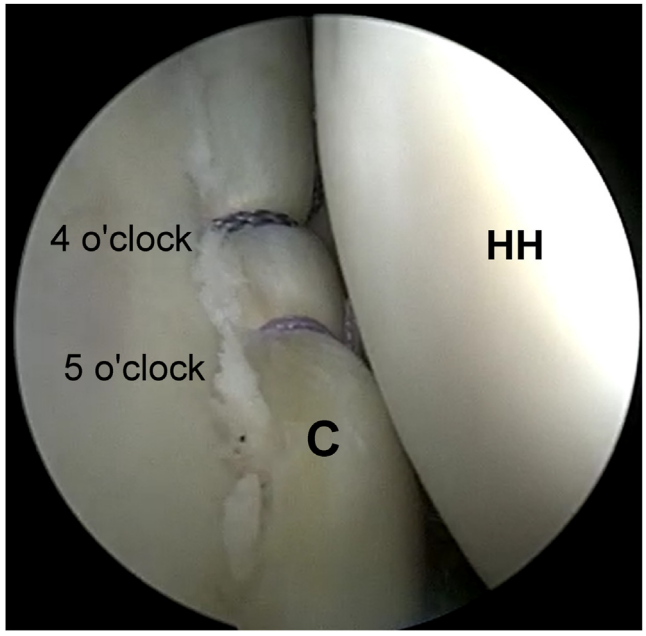

Fig 5. View from the posterior portal of the right shoulder in the beach-chair position. To avoid creating excessive "bumpers," the same procedure is repeated once or twice to repair the inferior glenohumeral ligament complex until it reaches approximately the 4-o'clock position. (C, capsulolabral complex; HH, humeral head.)

Management of postoperative deficits in the range of motion is complicated because some throwers have inherent laxity, which is a large individual difference. A delicate balance between the stability and laxity of the shoulder at maximum external rotation during the late cocking phase is crucial for a better return to the same competition level in overhead-throwing athletes.

Pouliart and Gagey,[7] in a morphologic cadaveric study, reported that the MGHL and IGHL were seen as the band defined by arthroscopy in the resting position, and when the arm was moved into full abduction and external rotation, all bands progressively disappeared. This finding indicates that the baseline anterior glenohumeral capsular ligament tension is preferably confirmed at the ABER position, as in our procedures.

Funakoshi et al.[8,9] reported that hypoplasia of the MGHL contributes to internal impingement as the result of anterior instability in overhead-throwing athletes. They described that hypoplastic MGHL may cause decreased function in the stabilization of the shoulder joint, especially in the late cocking phase of the throwing motion. We consider that this surgical technique not only provides sufficient postoperative external rotation in abduction but also improves the return to play rate in overhead-throwing athletes because of the retensioning of the anterosuperior glenohumeral capsular ligaments, including the MGHL, an important stabilizer of the anterior shoulder.

One of the advantages of intraoperative tensioning at the ABER (DAGHT) is that it enables determination of appropriate patient-dependent tensioning of the whole anterior glenohumeral capsular ligament to mimic the throwing motion, even though an unaddressed laxity or inherent looseness of the anterior glenohumeral ligament exists. Conventional ABR techniques may have achieved the end range before the ABER position, which is required for the throwing motion, resulting in the restriction of external rotation in abduction.

This study has the following limitations. This report describes a surgical technique, and clinical and biomechanical studies comparing this technique with conventional ABR are necessary to confirm its efficacy. To avoid intraoperative glenohumeral capsular ligament overtightening, the site of suture passage in the ABER position was decided on the basis of the subjective judgement of the operating surgeon. Finally, if the anterosuperior glenohumeral capsular ligaments, including the MGHL, are hypoplastic, restoring anterior stability using our surgical technique would be difficult.

In conclusion, ABR with DAGHT allows less restriction of external rotation during abduction. Therefore, we consider this surgical technique to be reliable for traumatic anterior instability of the dominant shoulder in athletes who wish to return to overhead-throwing sports.

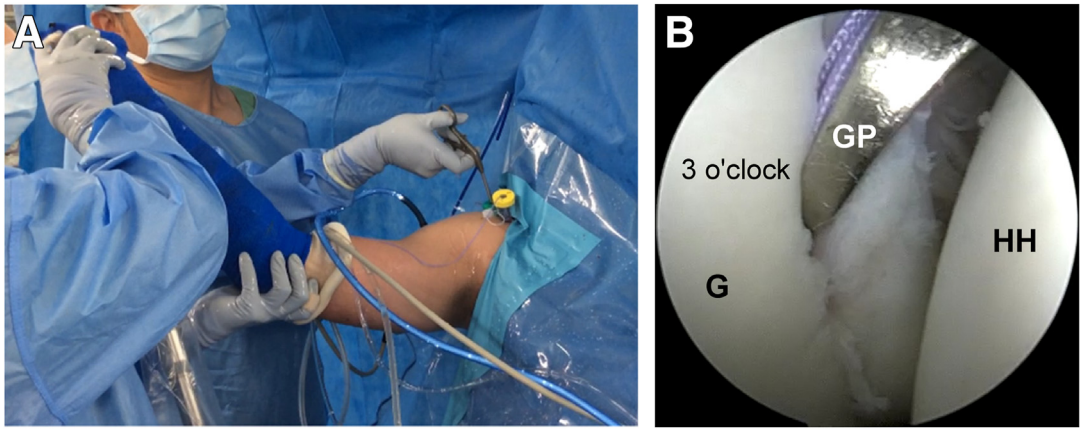

Fig 6. View from the posterior portal of the right shoulder in the beach-chair position: dynamic anterior glenohumeral capsular ligament tensioning in abduction and external rotation position technique. (A) The anterosuperior glenohumeral capsular ligament is dynamically evaluated in the mimic position during the throwing motion. (B) The ideal tension of the anterosuperior capsule is determined using a grasper. (G, glenoid; GP, grasper; HH, humeral head.)

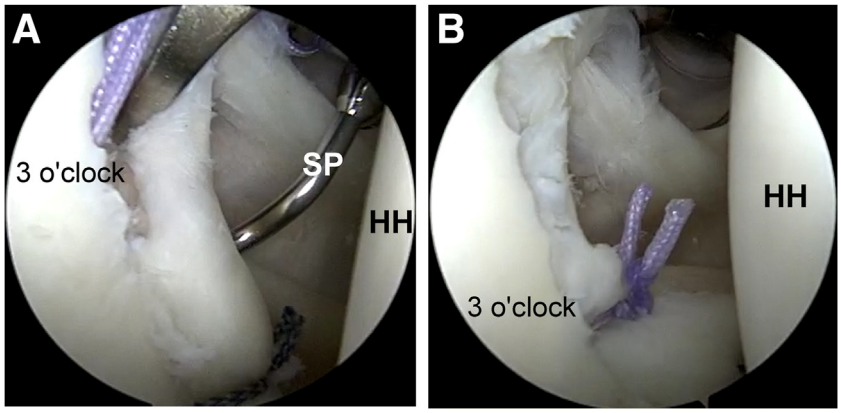

Fig 7. View from the posterior portal of the right shoulder in the beach-chair position. (A) The suture is passed through the capsulolabral complex of the location grasped by the grasper and (B) tied firmly. (HH, humeral head; SP, suture passer.)

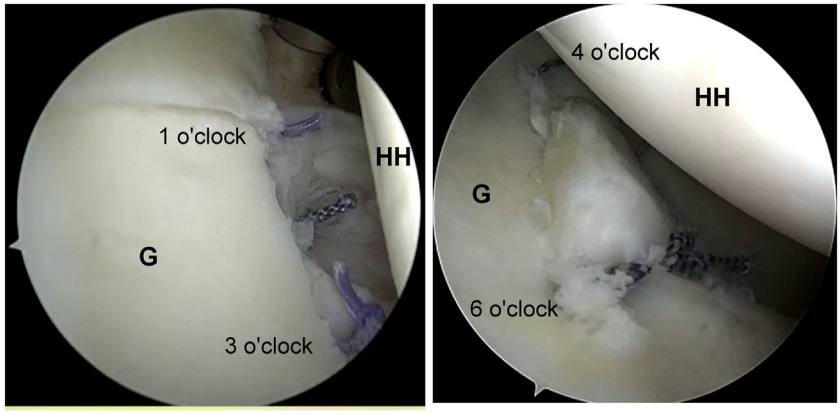

Fig 8. View from the posterior portal of the right shoulder in the beach-chair position: final view of the anterosuperior sutures after the dynamic anterior glenohumeral capsular ligament tensioning technique. (G, glenoid; HH, humeral head.)

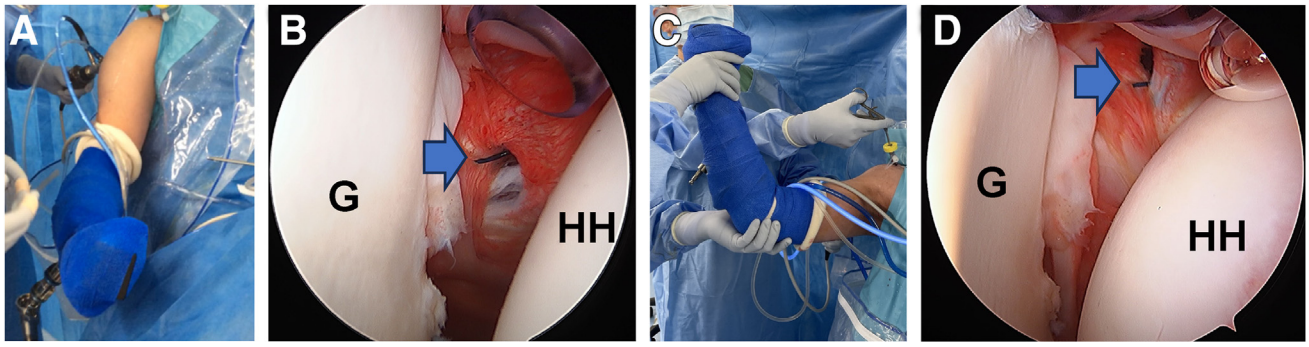

Fig 9. Dynamic evaluation of the anterosuperior capsule at the mimic position in the throwing motion. (A) Resting position with a limb positioner. (B) Arthroscopic findings of the right shoulder at resting position from the posterior viewing portal: The nylon is sutured to the middle glenohumeral ligament as a mark. (C) Dynamic evaluation of the anterosuperior capsule at the abducted external rotation position without a limb positioner. (D) Arthroscopic findings of the right shoulder at the abducted external rotation position from the posterior viewing portal: The nylon suture shows drastic lateral and cranial movements. (G, glenoid; HH, humeral head.)

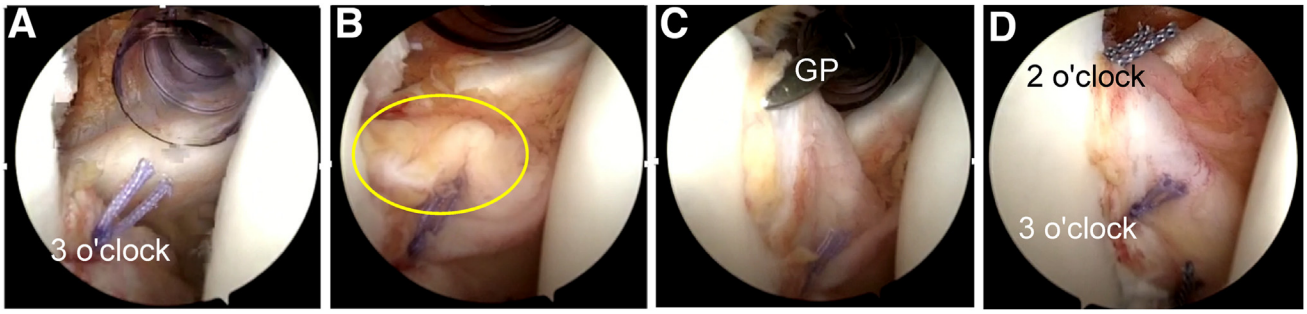

Fig 10. View from the posterior portal of the right shoulder in the beach-chair position: Another case of anterosuperior capsule invisible in the resting position. (A) The anterosuperior capsule is invisible in the resting position. (B) The anterosuperior capsule (oval) is visible in the abduction and external rotation position. (C) The ideal tension of the anterosuperior capsule is confirmed using a grasper. (D) The appearance after securing the anterosuperior capsule. (GP, grasper.)

Disclosures

All authors (Y.M., T.F., Ko.H., Ka.H., A.M., H.N., and M.G.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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